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ABSTRACT

This document discusses current thinking and research on projects and their management, particularly in regard to performance variables. Part one defines project management, discusses its relation to education and considers the need for a conceptual framework. Part two focuses on the purpose, assumptions, components, and external environment of a conceptual framework. Part three describes current research findings. The summary of the document states that the studies cited in part indicate that research is available regarding the relationship between components and dimensions of a conceptual framework for project management. A list of references is included. (Author/JS)

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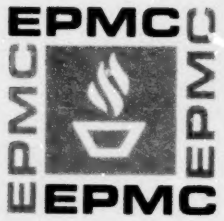

A CONCEPTUAL FRAMEWORK FOR THE STUDY OF PROJECT MANAGEMENT IN EDUCATIONAL RESEARCH AND DEVELOPMENT

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PREFACE

The ideas set forth in this paper represent a current state of thinking and reflect an evolving and emerging interest in the phenomenona of projects and their management. The original intent was to develop a mathematical model designed to explain and predict successful project performance vis-a-vis project selection. Careful consideration of this process and its fruits lead to a conviction that project selection was a part of a still larger complex and that mathematical modeling, while a substantial ideal to achieve, was premature. The ultimate performance of a project is related to a wide series of variables. It was deemed necessary to do initial and exploratory work with regard to those variables, particularly with regard to fitting them into some structure or conceptual framework.

Initial support for this research effort came from two grants provided by the Research Committee, College of Education, The Ohio State University starting in 1970. An initial presentation of the ideas was made at the Houston meeting of the Project Management Institute in 1972. Additional discussions with colleagues, the reading of research studies in project management, conversations with project managers, and student contributions in class and seminar discussions have led to selected modifications in the conceptual framework. Such modifications are considered normal in the development of ideas contained and presented in this paper.

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Columbus, Ohio
April 1975

I - EMERGENCE OF THE PROJECT MANAGEMENT CONCEPT

As a concept, project management is of relatively recent orgin having come into the experience and literature of management largely during the past two decades.

It is not possible to state exactly when the concept began to emerge as a viable management concept and field of expertise. The study by Peck and Sherer titled The Weapons Acquisition Process in the late 1950's reviewing the life history of military weapons development projects highlighted the management issues and concerns involved in efforts of a one-through nature characterized by dimensions of uncertainty. The problems were of sufficient magnitude that the Department of Defense held a conference on Program Management in 1963 (39). Numerous reports and documents have been published describing its history, development, and practice. Those interested in pursuing the concept in depth beyond the comments presented here are urged to read the writings of Archibald and Villoria (4), Baumgartner (10), Cleland and King (15), Cook (17), Keats (27), Middleton (34), Woodgate (48), Avots (7), Steiner and Ryan (44), and the Department of Defense Program Management Conference Proceedings (39). The main intent of this section is to provide the "reality" which the paper attempts to represent.

Project Management Defined

Briefly defined, project management is concerned with the application of the classical management functions of planning, organizing, directing, and controlling as well as current thinking on information/decision/system/theory to efforts nominally identified as projects. Projects are activities carried out within organizational environments and have several definitive characteristics. Prime among these is an identifiable end product to be accomplished within specified performance, time, and cost dimensions. Projects have a life cycle in the sense they are conceived or born and they die or terminate. Projects are by their nature creative since they must be conceived. There is usually no past history to guide the effort thus they are fraught with uncertainty. The need for integration is paramount to insure project success.

The developing practice has been to identify the project as a separate entity within an organizational structure and provide it with its own leadership and resource support. Thus, the role of the project manager has been formed. The project manager must produce the specified results within established time, cost, and performance

limitations. He must continually monitor and evaluate the project effort and make or force necessary decisions in order to make needed adjustments. He may even be forced to make recommendations for termination if the proposed objectives cannot be achieved. The project manager is usually considered the single responsible individual for the total project effort. He is often involved in the creation as well as the execution of the project. His main task is to work himself out of a job. The project manager bearing full responsibility must work closely with existing organizational functions but often without the clear and necessary authority to make needed decisions. Conflicts arising between authority levels and decision points can be detrimental to project success.

Project Management in Education

The field of education has also had its concerns with the concept of project management. Many personnel have attempted to work up solutions or answers to some of the problems if not just to elucidate their existence. The Second National Study of PACE (Projects to Advance Creativity in Education) in November 1968 described a comprehensive model for managing a Title III project from conception to culmination (16). The problems involved in initiating work on a Title III project led Benningson and Nixon (12) to describe and elaborate upon the development of a project management system. The importance of a strategic approach rather than a tactical approach to project management system design was stressed by these efforts. Hanna (23) has outlined and discussed problems associated with implementing project management in a local school district. The author of this paper has attempted in a book entitled Educational Project Management (17) to outline the basic dimensions of a project management model or system for educational projects.

Need for a Conceptual Framework

The above discussion highlights the emergence of project management as a viable management concept and the concerns existing on the part of both non-educationally and educationally related persons to develop better understanding of the concept through the process of developing conceptual models and/or frameworks.

Accepting the reality of the concept as described above there appears to be actually very little known about that set of factors or variables crucial to the management of a project. Various dimensions of the problem have been subjected to research efforts. Some concern has existed over the selection of projects initially with the hope that careful screening of proposals would lead to successful project execution. Baker and Pound (8), and Dean (20) have

excellent reviews of research on this concern. Some concern has also existed over the nature of the project manager, his attributes and behavior (18). Some research on criteria of project success and relevant independent variables has been conducted at the Sloan School of Management at MIT under a grant from NASA in connection with a more general effort to study R and D management (30). More recently, Baker, Murphy, and Fisher (36) reported the results of a study outlining perceived determinants of success. Using the results of their analyses, the authors developed a structure or framework integrating the variables investigated but only after the fact as contrasted to starting off with some established structure.

A survey of these several investigations, however, reveals few conceptual frameworks or guides to direct the derivation of relevant variables let alone study their interrelationships. For this reason, it seemed necessary to analyze the reality of project management in its current state-of-the-art and identify a set of relevant variables or components. In short, a model was needed.

Early in the developmental process it became apparent that the use of the term model was inappropriate. Modeling has a rather strict definition in common usage and is concerned primarily with trying to create a replica of a reality in both structure and function in order that the model can be used to explain and predict what will happen in the reality if certain variables and their attributes are modified. Models can exist in a variety of forms from simple physical representations through verbal and graphical representations to mathematical formulations. It was the original intent of this study to develop a mathematical formulation or model of project management. As work progressed, this aim was considered as being premature. It became more useful and less restrictive to talk about a conceptual framework for the study of project management than to talk about a model of project management. The term conceptual framework therefore has been employed in subsequent remarks in place of the concept of model. As the development of the conceptual framework continues, the development of a mathematical model in the true sense of the term still remains a highly desirable end product.

Organization of the Paper

This paper presents the conceptual framework of project management as currently envisioned. To present the framework, the next section is divided into three parts. The first part states the intended purpose or function of the framework. The second part states assumptions germane to the conceptual framework. The third part describes the components and dimensions and discusses possible relationships between them.

After presentation of the framework, the paper concludes with an outlining of selected research studies relating to project management in order to show how past research can be analyzed and synthesized to relate to the framework and how current and future research studies can be generated from the framework.

II - PURPOSE, ASSUMPTIONS, AND COMPONENTS OF THE FRAMEWORK

Purpose

Ashby (6) states that the first question to be dealt with in modeling is, what does one want the model to do? If there is a map to be drawn one needs to know a map of what for what purpose? Unless one can establish a purpose then it becomes difficult to know what should be included in the map or model or even its form.

At present, one basic purpose is considered to exist for the framework. That purpose is to have the framework serve as a vehicle for the conduct of a continuing program of research, development, and dissemination devoted to the creation of a knowledge base, and hopefully a theory, regarding the concept of project management operations in the field of education. The purpose itself takes the form of a hypothesis that such a framework can be used to direct research and development efforts in order to know more about project management than it would be possible to know without the benefit of such a guide.

Given the purpose stated above, the research efforts are to be directed toward validating the framework by identifying variables from completed or on-going research that have some degree of association with project management. Attempts would be made to answer such questions as do we have all relevant variables? Which variables are controllable and uncontrollable? What variables are most important in a given context? and so on. Research conducted through the framework might point out for example that the variables relating to project creation processes are more significant than are execution variables in achieving project success. If true, such a finding would have strong implications for effective training of educational personnel in the task of project creation.

Assumptions

The development and presentation of the conceptual framework was derived under certain assumptions. It is important that these assumptions be stated so that persons other than the original developer desiring to utilize the framework can be familiar with them. This section states the several assumptions underlying the present conceptual framework.

The first assumption is that it is reasonable, feasible, and practical to identify the forces in the environment having influence on the management of the project.

A second assumption is that of project management does not basically differ between public and private sectors or environments. Public sector here refers to the areas of health, education, and welfare. Private sector refers to corporate business and industrial enterprises. The public sector does not include defense-related support programs. The emphasis in the conceptual framework is given to educational settings represented by activities such as local school districts, state educational agencies, regional educational research and development centers, and college and university settings.

A third assumption is that the components, dimensions, and variables making up or constituting the conceptual framework can be quantified or measured on some form of nominal, ordinal, interval, or ratio scales and that interrelationships can be established among the variables.

A fourth assumption is that the most rationale approach to employ in identifying and establishing an optimum organization of relevant variables is to consider successful project completion and/or performance as a dependent variable and all other variables as independent variables.

Other assumptions will no doubt have to be made as the conceptual framework undergoes development. The assumptions set forth above represent an initial set considered in development of the present framework.

Components

The basic structure of the framework derives from systems theory in that it views the project as a processor unit whose function it is to carry out a specific task as an input and create an output. As with any system, an environment surrounds the Project into which the output goes and from which the task comes. In the structure presented here, two environments are considered based upon their

proximity to the project. With rare exceptions, projects operate within some structured immediate environment referred to here as the Parent Organization. The second level environment recognizes that the Parent Organization itself operates within a still larger environment referred to here as the External Environment. A graphic representation of the structure is presented as Figure 1.

Inspection of the figure reveals that the three major components are defined by boundary lines. The central bounded area is that of the Project. Within this boundary has been included the Task, the process itself labeled as Temporary Management system, and the Project Success or Output Criteria. The bounding was done on a premise that these elements are most commonly considered to be related to the concept of a project. The second bounded area is that of the Parent Organization surrounding the Project. The third level has been subdivided into three general elements. The first labeled Current Trends collects together a set of variables having some direct or indirect influence upon the project. A second element called Constituency or Market represents the ultimate user of the project output. The third element is that of the Customer or Funding Agency or the one normally providing the financial support. Recognition is given to structure which might include the latter component as part of the Parent Organization in contrast to being external to it. For the present, the framework is built on the idea that a person or agency outside the Parent Organization contributes all if not most of the necessary financial resources either under a solicited or unsolicited funding arrangement.

Directional areas have been inserted in the figure to show the direction of influence and/or the interaction between the possible components and elements.

Each of the three major components is described in further detail in the following sections. When possible potential variables and their states are identified. For convenience, discussion of the components will proceed from the External Environment to the Project.

External Environment

The most undefined set of variables is that labeled as Current Trends and consists of Political, Economic, Social, and Technological conditions existing in the environment at a given time. It is presumed that the current status of these conditions bears upon the project indirectly if not directly.

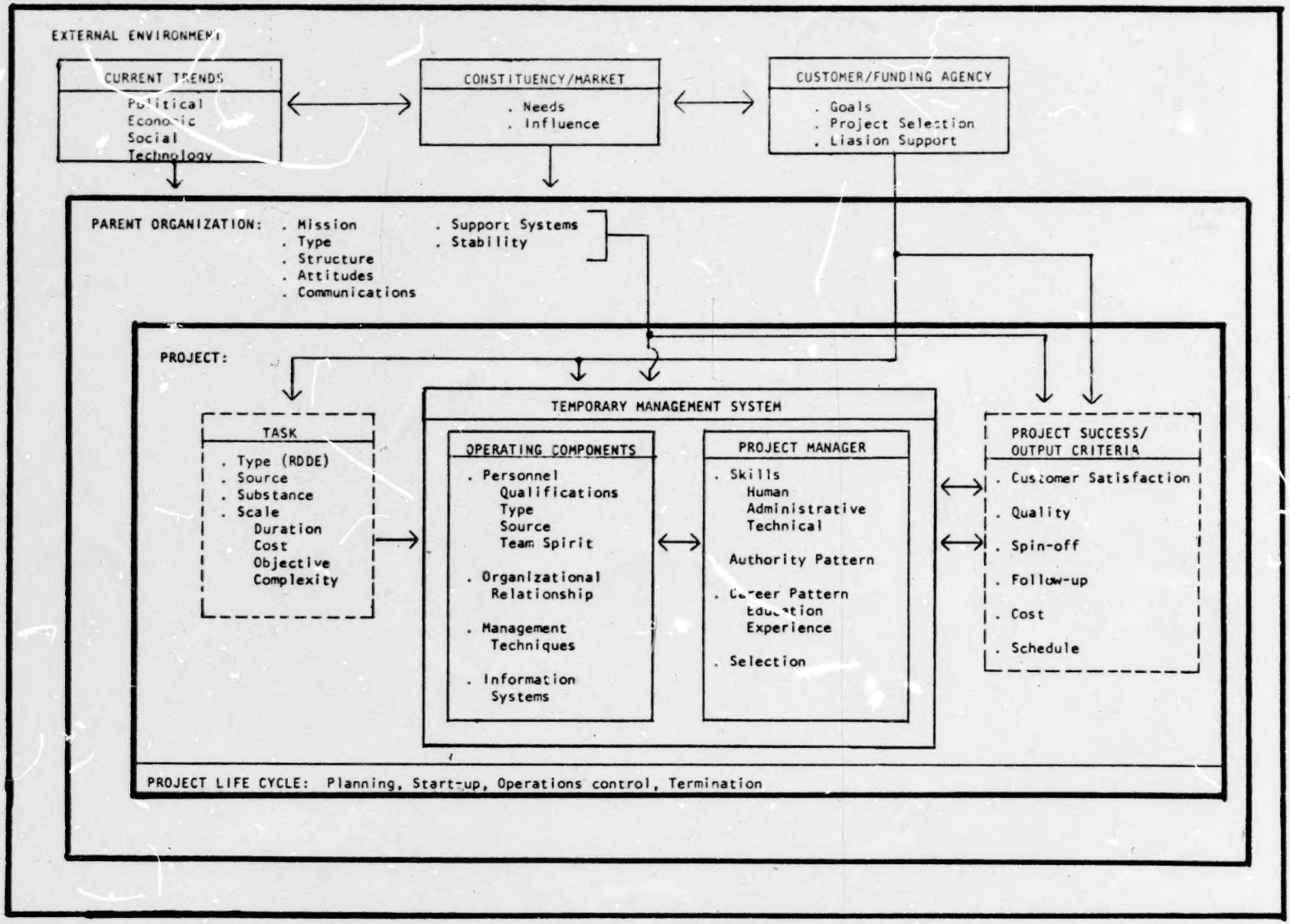

Figure 1 CONCEPTUAL FRAMEWORK FOR STUDY OF RDDE PROJECT MANAGEMENT

Political variables consists of executive and legislative attitudes, conditions, policies. and actions concerned with decisions to allocate resources to selected types of R and D efforts. Examples would be decisions about lunar landings, federal aid to education, war on poverty, energy research, environmental and drug education, and similar concerns.

Economic variables focus upon the general state of monies, exchanges, and even inflation. The impact of recessions as well as inflation upon project support and project activities becomes important. Inability to support research personnel in the Parent Organization because of economic conditions may have a strong impact upon ultimate project success.

Social variables focus upon general public acceptance of selected projects. Lunar landings at one time were popular but now are not so popular. In times of depression, projects designed to create jobs become popular.

Technological variables focus upon the availability of certain technical advances and their impact on a project. The development of electron microscopes, video tape cassettes, and minaturization of equipment, can play a strong role in the conduct of a project.

The interaction between the Political, Economic, Social, and Technological variables themselves are not well understood. As Appell notes (3), we do not have very well developed models to help in this area. Because of the lack of knowledge, it becomes even more difficult to relate specific variables in these areas to ultimate project success. It is felt however that their influence cannot be neglected in discussing conditions affecting project success and for that reason have been included in the framework.

The second component of Constituency or Market focuses upon variables relating to needs and influences deriving from the ultimate user of the project output other than the funding agency. The utility of a project output in the form of a packaged instructional program is determined by the student, teacher, administrator making up the educational constituency or market. The utility of a research report is determined by the constituency of researchers. The timeliness of an output to a need may determine its acceptability. It is not reasonable to act as if there were a single constituency when in fact there are many. As with Current Trends further definition is needed in this component.

The third component of Customer or Funding Agency focuses upon the agency interested in purchasing the skill to produce an output desired by that agency. Policy and program decisions determine those

tasks to be funded. Acceptance of the final product is often solely determined by the funding agency. In some cases, funding agencies have been known to change the nature of task during its completion, request change in the project manager, as well as determine the success of the output. For this reason, this component's influence has been shown by an arrow extending to all three subelements of the Project and to the Parent Organization. Liasion between the funding agency program manager, the Parent Organization representative, and the Project becomes a key factor in determining success. While neglect of the project may lead to negative output, over-supervision may produce an inhibiting effect. It is not known at this time what an effective liasion schedule is for any given type of project in any given Parent Organization. Among other variables to be considered are the customer's experience with project operations, their view of the project as investment opportunity, their methods of selecting contractors and/or general methods of project review and selection, their basic relations to the Parent Organization, their intentions with regard to utilization of the product upon completion of the effort, the qualifications and R and D experience of personnel in the agency, the periods of project funding, and similar factors presumed to effect the ultimate success of the project effort.

Under this structure, it might be possible for a project to be considered as successful by the Funding Agency but the Constituency might not accept or use the product since it judges it to be of a superficial nature or unsuited to its needs.

Parent Organization

This component focuses primarily upon the organizational setting housing the project. Recognition is given to the fact that several layers of structure often exist within any given organization. For instance, a school building within a school district, a department within a laboratory and so on. Basically, the parent organization is that structure having immediate responsibility for the project and which establishes or implements policies (travel, personnel, equipment, materials) under which the project must operate. Other units within a larger organizational structure generally make inquiries about the project by contacting this immediate unit. Within the parent organization component, seven general variable sets are identified.

The first variable set relates to the mission of the parent organization. Here a focus is upon the general purpose for being (teacher training, medical education, etc). The mission determines the type of project tasks which other members of the organization are permitted to undertake. There is thus a compatability between

the project and parent organization based upon the mutual relationship of objectives.

The second variable set focuses upon the type of organization. That is, is the organization a public agency or private concern? It is religious oriented or non-sectarian? It is a research institute or service agnecy? It is profit-oriented or non-profit oriented.

A third variable set is concerned with the structure of the parent organization. The focus is upon structures and hierarchies of authority, responsibility, and function. Concern would exist over difference in project operations under conditions of "matrix" structure as contrasted with a fully "projectized" operation. Reporting channels and decision channels would be of importance. Policies with regard to the authority and responsibility given to project managers would be a key variable of interest.

The general attitudes about the value of projects in general and specific projects constitute a fourth variable set. Consideration would be given to the project's contributions, both direct and indirect, to the parent organization. Organizational views with regard to the feelings about projects and their autonomy and impact would be important variables. The willingness of the organization to provide efficient facilities for conduct of the effort are viewed as being an important variable.

Since the project team is usually in a format whereby it makes use of the parent organization resources, communications between the project effort and the organization constitute a set of variables relevant to project success. Interpersonal communications on a formal and informal basis often determine an ability to develop solutions to problems arising in the project. Communication variables also include status reporting procedures to and from the project.

Most projects are not self-contained units and must draw upon a variety of organizational resources or support systems for project actions such as financial accounting, personnel recruitment, duplication, payroll, and similar support functions. This set of variables also includes the provision of physical space and facilities for the project. Location of the project in terms of its proximity to personnel with backgrounds germane to the project substance has been found to bear a strong relationship to successful research and development activities.

Current organizational theory stresses the need for organizations to adopt operating structures possessing more flexibility. To some degree, credence is given to the concepts of ad hocracy developed by Bennis and Tofler. Variables associated with organizational stability and change become of importance in view of their potential

Impact upon projects which themselves are temporary in nature. Long term stability of structure permits the project to concentrate upon its mission or reason for being and not drain its resources to maintain position in an ever-changing organizational patterning.

Project

In discussing project variables and relationships, a fundamental consideration is that the project be viewed as being a temporary effort with a defined life cycle. The life cycle can be divided into the four major stages of planning, start-up, operations, and termination. These four stages have been identified on the Figure I by use of a box running the length of the bounded area labeled as Project. In some sense, a task element can be closely related to the planning stage, a temporary management system element being related to start-up and operations phases, and the success criteria as being related to the termination phases although there is not necessarily a one-to-one definitional relationship involved.

Under a condition of temporariness, the component focusing upon a project existing within a given parent organization is viewed as consisting of three principal elements or sets of variables. One of these is considered as being under the direct control of the project manager and two are not so considered. The project task and the criteria by which its accomplishment is judged as being successful are felt to be variables sets largely uncontrollable by the project manager. With a few exceptions, the task is largely assigned to a project management group to carry out. Some research conditions do exist where the initiator of the task is also the person given the assignment of carrying it out (e.g., unsolicited research proposals in a university setting). Success criteria or judgements of project accomplishment are also viewed as being outside of the direct project manager's control. His success is largely judged by others (parent organization members, problem initiator, colleagues, funding agency, etc). The temporary management system consists of variables relating to operations involved in the conduct of the project. This element is considered to be highly controllable by project management. Each of the three major components of task, temporary management system, and success output criteria are detailed below.

Task As viewed as the present time this component is seen as consisting of a series of subvariables related to the basic characteristics of the task to be done and its orign. One major variable focuses upon the type of project in terms of whether or not it is a research, development, evaluation, or similar activity. A major consideration here is the degree of goal and path of uncertainty existing about the task. A research project exploring new ground with only a final report to be produced is different from a developmental effort

implementing known goals and procedural steps and possessing more certainty such as would be the case in the production of instructional packages.

A second variable set relates to the source or origin of the task in the sense of how did it come into the organization. Was it initiated by the organization and funded by an external agency? Did the organization respond to RFP? Was the project set up under a "sole source procedure"? Was there parent organizational screening of proposals before they were submitted?

A third variable set suggests that the technical substance of the project is a major variable. Included in this diminsion are considerations such as the qualifications of the organization to carry out the task, prior experience with similar projects, the specific task substance (test development as contrasted with curriculum development, etc). and similar elements relating directly to the nature of the task to be accomplished over and beyond the uncertainty element.

A fourth variable set consists of a series of variables appearing to have relationship to each other and for this reason have been collected under the concept of scale. Included here would be considerations such as project size in terms of number of personnel involved, complexity of task in terms of number of activities to be accomplished, the schedule of duration (short versus long), the total dollar amount, and such ideas as degree of labor intensity.

Temporary management system. Most management systems are designed to be functional in a steady state organizational structure such as might characterize the parent organization. In the case of a project, the management system established to set up to achieve project goals is best considered as being temporary and only in existence for the life of the project. Because of the temporary nature of both the project and the management system, the structure and function of its management system becomes much more amenable to modification than would the parent organization management system. That is, it can be more adaptative. For this reason, it is viewed as being a much more controllable component than the other two components of task and success criteria. Further, it is set forth that the project manager is the person with both the authority and responsibility for seeing that the management system is adapative as needed, or controllable. Within this component, two major variable sets of operations and project manager have been established.

The operation's variable set consists of a series of subvariables focusing on four major elements. The first set relates to personnel constituting the project team. Characteristics considered of importance are their qualifications, type (professional versus clerical),

source (recruitment from outside as opposed to parent organization assignment), and the ability to develop a team spirit or project team feeling. Many of the variables involved in small group work would be relevant here as well as variables relating to behavior of scientists in organizations. Also included would be the commitment of the personnel to the project, the job security provisions in the project situation, and the amount of authority given each person to carry out his assignment. The second set relates to organizational relationships and structures. Here interest is in the project organizational structure and the intergration of the personnel to achieve the goals of the project. It includes the relationship between the project and the parent organization recognizing that this relationship can be changed. The main concern, however, is with the internal project organization. A third set involves the techniques and tools employed to assist in monitoring and controlling the schedule costs and performance dimensions of the project. It is concerned with the degree of their presence as well as the nature and type. Tools and techniques here include devices for controlling and planning such as PERT, Gantt Charts, CPM, and other schemes for laying out tasks, schedules, resource requirements, and budgets. The fourth element of information systems relates closely to techniques but focuses upon the means by which the project director can have project problems called to his attention. For this reason, the focus is upon the procedures used for reporting, taking action on problems, and implementing corrections. It includes nature and frequency of staff meetings, project visitations, and similar mechanisms.

While some persons might place the project manager or director as part of the personnel set of operations, the role or function is separated here primarily because of the importance of the position. The principal responsibilty of the project manager is to be an integrator in that he must orchestrate the elements or the operations elements in order to achieve successful accomplishemnt of the task. As integrator, he becomes also the principal or final decision maker about direct project operations. The crucialness of this role becomes readily apparent under this perspective and leads to its being considered as a separate element.

As currently viewed, the project manager element is made up of four major variable sets. The first focuses upon the characterisitics of the project manager in terms of the types of behaviorial administrative, and technical skill needed and brought to the position. A second set relates to the authority given to the project manager to do the task. Authority is further divided into de jure and de facto and is concerned with the impact of legal versus personal authority in leading the project effort. A third set relates somewhat to the first but focuses upon the types of education

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and work experiences needed to be a successful project manager. A fourth variable set relates to the process of selection. Is the project manager recruited at the start of the project planning effort or after funding is approved? Does he come from inside the organization or from outside? What screening processes are involved? This set relates to how the project director is placed in the major position of directing the project effort.

Success/Output Criteria. As noted, the project manager must orchestrate the elements of the temporary management system in order to accomplish the project. A major question becomes, when is the project successful? The presence of this question led to the development of a component relating to this area.

As presently conceived, this component identifies several criteria which might operate independently or together in fashion to ascertain if the project was successful. Schedule success refers to completion of the project within the time limits established by the project contract. It could be measured by the percent of tasks completed on time or by ascertaining if the terminal date was maintained. Cost refers largely to budgeting and associates success with remaining within the proposed dollar cost for the effort. Cost overrun and under-run become important here. Quality refers to the performance dimension and attempts to determine if the objectives were achieved in terms of the standards or specifications set for products or processes. Customer satisfaction attempts to determine the degree to which the client or customer funding the project effort is satisfied with the effort results. Spin-off focuses upon the often residual effects of a project effort. Improved personnel skills acquired during the project effort which can be applied to other areas of the organization are part of this criteria. In addition, it would include new products and processes as well as skills. Follow-on refers to the extent to which agencies directly involved in the project are willing to fund additional efforts but which would not necessarily be due to a simple continuation of a particular effort. For example, a field test of prototype instructional package would not be considered here as follow-on but a new and different project effort caused by satisfaction with the capability of the current project effort would be included.

At present, the variables in the project success component are considered to be independent of each other and equally weighted. It is not unreasonable to believe that the six variables could be reconstructed into two sets. One set would be directly related to the project and consist of schedule, cost, and performance. A second set would be indirectly related to the project and would include customer satisfaction, spin-off, and follow-on. While considering the variables as independent and equally weighted, no attempt has

been made to establish any order of importance or to rank them.

The success variables operate as constraints upon the project manager as he attempts to complete the effort. That is, he must consider these success criteria but cannot do much about them. He cannot, for example, change his budget at will. Requisition of additional resources from the customer or parent organization can be done but they may not be supplied so he has to complete the effort with existing dollars. It is even possible to conceive of a situation where the project is completed on time, within budget, and of required quality control but the customer is not satisfied with the result because of conflicts developing during the project. While in one sense successful, the project manager won the battle but may have lost the war. Recognition is given to the possibility that the project director, the parent organization, and the funding agency each might have their own criteria of success. Quality performance might be the criterion used by the funding agency but completion within budget used by the parent organization since it doesn't want to use any of its own funds.

III - SOME CURRENT RESEARCH FINDINGS

Previous sections have outlined the purpose and structure of a conceptual framwork for project management in the field of education. During the course of developing the framework, several research studies focusing in on project management were encountered. This section presents some of the findings from these studies in order to provide illustrations of the nature and type of research that has been and could be carried out under the framework. The findings presented below are not meant to be an exhaustive treatment or synthesis of research on project management. Instead, they are designed to present certain findings which are already available and hence might be useful in supporting certain hypothesized relationships as derived from the framework.

M. I. T. Research Program

The most targeted research on project management has been that conducted under the Research Program on the Management of Science and Technology conducted under the direction of Dr. Donald P. Marquis of the Alfred P. Sloan School of Management at Massachusetts Institute of Technology (30). This research on project management was only one dimension of a larger effort started in 1962 under a financial support from the National Aeronautics and Space Administration.

As a consequence, the research results presented below focus mainly from this study of project management using a sample of projects in industry and/or government agencies. In most cases, they were large scale efforts involving aerospace activities. Even though their relevance to education might not be directly transferable, the findings can suggest possible hypotheses for educational situations. For convenience, the several studies reviewed have been categorized under selected topic headings in order to provide emphasis.

Selection of Project Managers. Swanson (45) studied the decision processes used by persons charged with the responsibility of selecting project managers. He developed a model for the decision process and related it to the steps in overall project development. One of the more interesting findings was the project manager could not properly be chosen before the project was defined. It was considered important to be sure that the prospective project manager understood the area of the project. The findings also indicated that the decision process was rather implicit and judgment was a primary factor in final selection. A list of desirable attributes was developed by Swanson from the comments provided by persons charged with project manager selection. The list of attributes is presented below.

1. Sufficient technical skill in the major field of interest in the project.
2. A sufficiently broad technical ability and background to be adequately conversant with all of the technical disciplines involved in the project.
3. Experience in negotiation and administration of contracts.
4. Can establish a team effort through abilities to work with people, command respect, and establish espirit de corps and enthusiasm.
5. Can communicate ideas and delegate responsibility for execution of ideas.
6. A good judge of people and can properly utilize and weigh expert opinion.
7. Possess agressiveness and drive.
8. Can properly plan the work of both himself and others.
9. Can properly assess and coordiante various requirements in broad areas of activity.

10. Can make timely decisions and establish proper balance between thought and action.

In presenting the list of attributes, Swanson considers them to be a minimum list rather than a maximum list. Different projects would require different weighing of these attributes but all would be required in some degree.

Success Criterion. Marquis (31) and Marquis and Straight (33) report on the development of a criterion for rating project success or performance. This was done by asking a group of experts including persons such as a laboratory manager, a project manager, a government monitor, and a contract administrator to rate project dimensions in terms of importance. The dimensions rated were technical performance, schedules, and costs. Based upon the judgment of experts, technical performance was considered to have the highest weighting followed by schedules and costs with lesser emphasis.

Project Performance and Selected Project Factors. Using the performance criterion developed and described in the above paragraph, several studies were conducted in which various project characteristics and project manager factors were studied. The basic format of these studies was largely of a relationship nature in which selected variables were correlated with ratings obtained by experts on the performance or success of the project.

Rubin (41) investigated several factors and the general findings of this study are presented below.

1. The number of full-time professionals employed on a project was positively related to the internal priority given to the project.

2. Large-scale projects were given high levels of priority in organizational structure.

3. High priority large-scale projects were assigned older and more experienced project managers.

4. Project managers selected for sole source as contrasted with competitive contracts had significantly less project management experience than did project managers selected for competitive projects.

5. No relationship was found to exist between project type (sole source versus competitive) and size or priority of project.

6. A high relationship was found between prior project experience and years of total experience for project managers.

7. A high relationship existed between years of experience and responsibility for a project as measured by ratio of current project dollar amount to prior project dollar amount (responsibility index).

8. Responsibility index as measured by current/past dollar ratio was not related to any of the project characteristics.

Using characteristics such as priority, project manager experience, and type of project, Rubin related measures of technical performance to the selected set. The findings observed from this portion of the study were as follows:

1. Technical performance was negatively related to amount of prior project experience on the part of the project manager.

2. Sole-source projects achieved higher levels of technical performance than did competitive projects.

3. The higher the internal order of the project the greater or better the technical performance of the project.

4. Years of total experience for the project manager was unrelated to technical performance.

5. A high responsibility index was related to technical performance on the project.

6. No relationship existed between technical performance and the project manager characteristics such as length of service with company or time from first baccalaureate degree to first supervisory job.

In a similar study Rubin and Marquis (42) combined to investigate several additional factors as they might relate to project technical performance. Using procedures similar to the other studies, the following findings were obtained.

1. Sole-source contracts do better in technical performance than competitive projects.

2. The less effort in the total project that was sub-contracted the better the technical performance.

3. The inclusion of a safety factor (fudge factor or slack) in time and cost in the initial estimates was positively related to high technical performance.

4. A high absolute number of key people and a large number chosen on basis of specialized talent was associated with high technical performance.

5. No restrictions on the choice of sub-contractors were associated with poor technical performance than was the case when restrictions were applied.

Marquis (31) summarized much of the current findings conducted under the NASA-sponsored program in a article in the magazine Innovation. He reports a summary of six factors and their possible influence on project performance. Some of the factors were previously reported in articles by Rubin and Rubin and Marquis, but additional ones were reported in the Marquis article. Among the findings reported and discussed were the following.

1. Functional organization of technical personnel was positively related to technical performance while functional organization of administrative personnel was not influential.

2. Complete project teams including both technical and administrative personnel were associated with lower technical performance but more likely to meet established cost and schedule deadlines.

3. No relation was found to exist between the formal authority of the project manager and the actual success of the project.

4. No significant differences were observed between projects which used PERT and those which did not with regard to technical performance.

In addition to the types of empirical research represented by the work of Rubin and Marquis, interview-type studies were made as noted in the case of Swanson above and that reported by Osborne (37). Osborne interviewed project managers, support managers, and persons persons having prime responsibility for projects in five major concerns and three government organizations developing weapons systems. From this series of interviews, he identified five major factors which appear to be relevant to project success. These five factors were as follows.

1. The characteristics of the original proposal and the methodology of its development.

2. The level of responsibility given to the project, its placement in the organizational structure, and the degree of authority provided the project manager.

3. The staffing or selection, acquisition, and motivation of project personnel.

4. The fractionalization of work or the division of work, the assignment of tasks, identification of problem areas, progress evaluation, and related task assignments.

5. The establishment of adequate project controls for the determination of physical accomplishment and program costs including schedules, contract administration, office management, and related ideas.

Boston College-NASA Study

One of the more recent research studies was conducted by Murphy, Baker, and Fisher (36) under a grant from NASA to determine the relationship between a wide set of project characteristics and project effectiveness. Using a questionnaire approach with a sample of about 600 projects from business, industry, and the government, a set of 200 plus individual items were factor analyzed into a set of some 50 factors. In turn, these factors were placed into a path analysis model. The analysis pointed up that the variables collected themselves into six major groupings. These were External factors over which there was very little control or were pre-existant conditions for the project; Process/External factors external or predetermined for the project but discretionary in the larger system; Process factors essentially discretionary or specific to the project; Output/Process factors representing both end project and facilitating characteristics; Output factors or end products of the specific effort; and Success factors assessing the project output. The authors present collections of variables affecting project success under the general categories of Project Manager, Project Team, Parent Organization, Client Organization, Managerial Techniques, and Preconditions.

O. S. U. Research Program

Concurrent with the development of an initial draft in 1970 of

the conceptual framework presented in this paper, the author initiated an effort under the acronym Project RASP (Research Analysis and Synthsis Project). The fundamental purpose or objective of this effort is to assemble published and fugitive articles and papers dealing with research relating to project management from whatever sources (education, engineering, business, etc.) making contributions to the field. In addition to this effort, several graduate students have initiated thesis and dissertation projects using the conceptual framework as a basis of hypothesized relationships or the development of questions for answering.

Cook, Kerns, and Damcio (18) undertook a study designed to determine the duties and responsibilities of project managers in educational settings. Using a sample of project managers, project evaluators, and educational project auditors, each person was given a list of duties and responsibilities and requested to check if they did actually perform the duties or if they felt they should perform the duties. The findings indicated that the actual duties focused around concerns over administrative detail and housekeeping matters.

Wagner (47) investigated possible relationships between the fulfillment, satisfaction, and importance of personal needs and project manager performance in a series of the Title III projects. While not statistically significant, relationships between high performance and satisfaction of all needs were postive. The fulfillment of self-realization needs and the importance of security needs also appeared to be related to high performance ratings.

In order to develop a concept of project management authority to guide further research on this variable, Jennings (24) conducted a content analysis of selected writers in the area of project management. She found that the major elements of the authority were the de facto and de jure conditions. Further, the study revealed that there has been some gradual clarification of the concept of project management authority over time. At the same time, the writings tend to be focused more on traditional prescriptive administrative management as contrasted to more current behavioral approaches to management.

Recognizing the function of project success as a major dependent variable in the conceptual framework, Ball (9) investigated the relative rankings of possible criteria of success. The findings showed that project directors and parent organization representatives tended to rank the six criteria in the same relative order. The general order of ranking was Quality/Performance first followed by Customer/Client Satisfaction, Spin-off Benefits, Follow-on work,

Costs, and Schedule last. Rating of actual projects (small grants) using the criteria showed a high relationship between the ranking of criteria as noted and the actual ranking of the project using the same criteria.

Summary

As stated above, the previously mentioned studies indicate that some research is already available with regard to the relationship between components and dimensions of a conceptual framework for project management. The development of the framework into its present form can lead to generation of hypotheses which can be subjected to similar types of empirical tests in order to validate the framework.

REFERENCES

1. Ackoff, Russell L., Scientific Method: Optimizing Applied Research Decisions, John Wiley and Sons, Inc., New York (1962).

2. Andersin, Hans E., "On the Design of Goal Formation Procedures for a Sales Organization by the Use of Computer Simulation and Control Theory," Model and Simulation (Ed. H. Stockhaus), Gothenburg School of Economics and Business Administration, Göteborg (1970).

3. Appell, George, "The Pernicious Effects of Development," Fields Within Fields, No. 14, Winter 1975, pp. 31-41.

4. Archibald, R. and Villoria, R., Network Based Management Systems, John Wiley and Sons, Inc., New York (1967).

5. Arrow, Kenneth, "Mathematical Models in Social Sciences," The Policy Sciences, Stanford University Press, Stanford (1951).

6. Ashby, W. Ross, "Analysis of the System to be Modeled," The Process of Model Building in the Behavioral Sciences (Ed. R. M. Stogdill), The Ohio State University Press, Columbus, Ohio (1970).

7. Avots, I., "Why Does Project Management Fail?," California Management Review, XII, Fall, pp. 77-82 (1969).

8. Baker, N. R., and Pound, W. H., "R and D Project Selection: Where We Stand," IEEE Transactions on Engineering Management, Vol. EM-11, December, pp. 124-134 (1964).

9. Ball, Rodney, A Feasibility Study of Developing Success Criteria for Educational Research and Development Projects, Ph.D Dissertation, The Ohio State University, June 1974.

10. Baumgartner, John S. Project Management. Richard D. Irwin Co., Homewood, Illinois (1963).

11. Beer, Stafford, Decision and Control, John Wiley and Sons, Inc., New York (1966).

12. Benningson, Lawrence A. and Nixon, J. E., Educational Program Management: A Project Management Application and Discussion, Reprint Series, Graduate School of Business Administration, Harvard University (no date).

13. Brodbeck, May, "Models, Meaning, and Theories," Symposium on Sociological Theory, Row, Petersen, pp. 373-403 (1959).

14. Bross, Irwin D. J., Design for Decision, Macmillan Co., New York, Chapter 33 (1953).

15. Cleland, D. I. and King, W. R., Systems Analysis and Project Management, McGraw-Hill Book Company, New York (1968).

16. A Comprehensive Model for Managing an ESEA Title III Project From Conception to Culmination, Report No. 3 of the Second National Study of PACE, Center for Effecting Educational Change, Fairfax, Virginia (November 10, 1968).

17. Cook, Desmond L., Educational Project Management, Charles E. Merrill Company, Columbus, Ohio (1971).

18. Cook, Desmond L.; Kerns, Wilmer; and D'Amico, Sandra., An Investigation of the Responsibilities and Duties of Educational Project Managers, Educational Program Management Center, The Ohio State University, Columbus, Ohio (September, 1970).

19. Cook, Desmond L., PERT: Applications in Education. Cooperative Research Monograph No. 17, Office of Education, Department of Health, Education, and Welfare, Washington, D. C. (1966).

20. Dean, B. V., Evaluating, Selecting, and Controlling R and D Projects, Research Study 89, American Management Association (1968).

21. Forrester, Jay W., Industrial Dynamics, John Wiley and Sons, Inc., New York (1961).

22. Gaddis, Paul O., "The Project Manager," Harvard Business Review, Vol. 37, pp. 89-97 (June, 1959).

23. Hanna, John, Project Management in an Educational Environment, Proceedings of the Project Management Institute Seminar/Symposium, St. Louis, Missouri (October, 1970).

24. Jennings, Linda, An Investigation of the Evolving Structure and Function of Project Management Authority, Master's Thesis, The Ohio State University, March 1975.

25. Kac, Mark, "Some Mathematical Models in Science," Science, Vol. 166, pp. 695-699 (November 7, 1969).

26. Kaplan, Abraham, Conduct of Inquiry, Chandler Publishing Company, San Fransisco, Chapter VII (1964).

27. Keats, E. S., "How to Become a Good Project Manager," Aerospace Management, pp. 20-23.(August, 1963).

28. Maccia, E. S., The Model in Theorizing and Research, Occasional Paper 65-180, Bureau of Educational Research and Service, The Ohio State University, Columbus, Ohio (1965).

29. Management Training Program for Educational Research Leaders. Final Report Grant No. 8-0167, Office of Education, Department of Health, Education and Welfare, Washington, D. C. (June, 1969).

30. Marquis, Donald G. (Ed.), Research Program on Management of Science and Technology, Second Report 1965-67, Sloan School of Management, Massachusetts Institute of Technology, Boston (October, 1967).

31. Marquis, Donald G., "A Project Team Plus PERT Equals Success or Does It?," Innovation, Vol. 5 (1969).

32. Miles, Mathew B. (Ed.), Innovation in Education, Bureau of Publications, Teachers College, Columbia University, New York (1964).

33. Marquis, D. G. and Straight, Jr., D. M., "Organizational Factors in Project Performance," Research Program Effectiveness, Gordon and Breach, Inc., New York (1966).

34. Middleton, C. J., "How to Set Up a Project Organization," Harvard Business Review, XIV, pp. 73-82 (March-April, 1967).

35. Morris, William T., "On the Art of Modeling," The Process of Model Building in the Behavioral Sciences (Ed. R. M. Stogdill), The Ohio State University Press, Columbus, Ohio (1970).

36. Murphy, D. Baker, B. and Fisher, D., Determinants of Projects Success, Final Report, Grant Number NGR 22-033-028, National Aeronautics and Space Administration, September 1974.

37. Osborne, James T., Factors in Project Success, Sloan School of Management, Massachusetts Institiute of Technology, Boston (1962).

38. Peck, M. J. and Sherer, F. M., The Weapons Acquisition Process, Harvard University Press, Cambridge, Massachusetts (1962).

39. Proceedings of Conference on Program Management, Department of Defense, Washington, D. C. (May, 1963).

40. Roberts, E. B., "How the U. S. Buys Research," International Science and Technology, Vol. 33, pp. 70-77 (September, 1964).

41. Rubin, Irwin M., Project Management and the Role of the Project Manager, Working Paper 222-66, Sloan School of Management, Massachusetts Institute of Technology, Boston (October, 1966).

42. Rubin, I. M. and Marquis, D. G., Critical Decisions in Initiation and Development of Projects, Working Paper 192-66, Sloan School of Management, Massachusetts Institute of Technology, Boston, (June, 1966).

43. Rapaport, Anatol, "Uses and Limitations of Mathematical Models in Social Science," Symposium on Sociological Theory, Harper and Row, Inc., New York (1959).

44. Steiner, G. A. and Ryan, W. G., Industrial Project Management, Macmillan Company, New York (1968).

45. Swanson, A. G., Selection of Project Managers in a Government Research Laboratory: A Study of the Decision Process, M. S. Thesis, Sloan School of Management, Massachusetts Institute of Technology, Boston (1964).

46. A Training Program in the Use of Management Information Systems in Educational Research and Development Activities, Final Report rant No. OE6-2786, Office of Education, Department of Health, Education and Welfare, Washington, D. C. (June 30, 1967).

47. Wagner, John, Relationships between Personal Needs and Performance Ratings of Educational Project Managers, Ph.D. Dissertation, The The Ohio State University, June 1974

48. Woodgate, H. S., Planning by Network, Second Edition, Business Publications, Ltd., London (1967).